

winds of elastic expansion, such as are the hot winds of India and Australia; winds which are distinct from convection currents, though, it may be, coexisting with and accelerating them. The relations of these winds to the barometric tides are very marked, but it does not seem that the differences of tidal pressure would suffice to generate them, were there not a movement of the air in the same direction arising from more persistent differences of pressure. They probably also depend much on local and irregular differences of pressure.

The air thus removed in the day-time from continental areas must, of course, collect over the nearest areas of evaporation, with the effect of diminishing the mid-day fall of pressure over those tracts; and thus seems to be explained those apparent anomalies in the magnitude of the mid-day semi-oscillation of the barometer to which, in the passages quoted from Mr. Buchan's memoir, he has drawn attention, viz., in the case of the Mediterranean area and the Atlantic coast of North America.

The direction in which this movement of the air takes place will, of course, vary with the locality, but there will always be, on an average, a greater diurnal movement towards east coasts than towards those facing to the west. This may be illustrated by the case of Calcutta and Bombay, and it is more extensively illustrated by the predominant westerly direction of the land-winds of India, and the cold westerly diurnal winds¹ that blow across the high plains (17,000 to 19,000 feet) of the Changchenmo and Rupshu in Western Tibet. The reason is sufficiently obvious. As the great waves of pressure advance from east to west, the local barometric gradient of any place (in so far as it is determined by the diurnal oscillation) will be expressed by a tangent to the existing phase of the wave. During the hottest part of the day, viz., from 9 or half-past 9 to half-past 4 or 5, this gradient (which is the steepest and most prolonged of the four) inclines to the eastward, and increases the declivity towards east coasts arising from the excess of pressure over the land. In the opposite direction, viz., towards west coasts, it goes to diminish that declivity. At night the case is reversed. The west to east barometric gradient from 10 P.M. to half-past 3 or 4 A.M. is in the same direction as that tending to produce an influx of air from the sea towards the land on west coasts; this, however, is opposed to the land wind of the coast line, which is a true convection current, and arises from quite different causes; and, although traceable in the wind variation at Bombay, it there manifests itself only by decreasing the velocity of the former. There are, moreover, independent grounds for the inference that this compensating in-flow chiefly affects the higher strata of the atmosphere, while the day wind is chiefly produced in the lower and more heated strata. At Calcutta the easterly (or negative westerly) tendency of the wind at night is very prominently exhibited in the curve of diurnal variation, but although of longer duration it is at no time so intense as the westerly tendency in the early afternoon hours.

In like manner may be explained the difference of epoch of the corresponding phases of the semi-diurnal east and west variation at Calcutta and Bombay. The gradient of pressure, in so far as it depends on the semi-diurnal oscillation, will, of course, be to the west with a rising pressure, and to the east with a falling pressure, and this normal tidal gradient is affected by the small difference of amplitude over land and sea, in such manner that its changes will be accelerated as affecting east coasts, and retarded as affecting west coasts. Now if we suppose that the acceleration in the one case and the retardation in the other amount to an hour or an hour and a half, and that the interval between the change in the direction of the gradients, and their effects on the wind, as manifested by the anemometer, is also about an hour

and a half, we should roughly reproduce the conditions shown to exist at Calcutta and Bombay respectively.

According to this view, the local static pressure of the atmosphere, apart from irregular movements, is shown by the height of the barometer at the hours of minimum pressure, and the difference of these expresses the weight of the atmosphere removed and restored by the oscillatory movements chiefly between land and sea.

I should add, in conclusion, that this communication is merely a *résumé* of some of the more salient topics discussed in two papers, "On the Winds of Calcutta," and "The Theory of Winds of Elastic Expansion," which will shortly be published *in extenso* elsewhere.

H. F. BLANFORD

CARBONIFEROUS LAND SHELLS

IN a recent visit to the South Loggius, in Nova Scotia, in which I was assisted in the examination of the cliff by Mr. Albert J. Hill, Manager of the Cumberland Coal Mine, we found a number of well-preserved shells of *Pupa vetusta*, in the indurated clay, filling an erect sigillaria, in a bed considerably higher than those in which the shell was previously known. It is nearly in the middle of group xxvi. of my section of the South Loggius, 222 feet above the main coal-seam, 842 feet above the bed in which the species was first recognised by Sir C. Lyell and myself, and about 2,000 feet above the lowest bed in which I have yet found it. It thus appears that this little pulmonate continued to flourish in the carboniferous swamps, after its remote ancestors had been covered with 2,000 feet of sediment, including many beds of coal, and nearly the whole thickness of the productive coal-measures. *Conulus priscus*, the only other land-snail found in this section, on the other hand occurs only, so far as known, in the lowest of the beds above-mentioned. Two other carboniferous land-shells, *Pupa vermilionensis*, Bradley, and *Dawsonella Meeki*, Bradley, have been found in the coal-field of Illinois; and it is worthy of remark that, according to Dr. P. P. Carpenter, all the four species belong to distinct generic or sub-generic forms, and that all these forms are still represented on the American Continent.

On the same visit, we were so fortunate as to find another large sigillarium stump, rich in reptilian remains, which it is hoped may, on examination, afford new species and further information on those already known.

J. W. DAWSON

THE BIRDS OF KERGUELEN'S LAND¹

AS regards the publication of results achieved by the naturalists accompanying the recent Transit expedition, our American friends appear to be getting the start of us. While we are engaged in issuing "preliminary reports," they have already arranged and classified their collections, and are beginning to publish their discoveries. The specimens of birds obtained by Dr. Kidder, surgeon and naturalist attached to the astronomical party at Kerguelen's Land, or Desolation Island, have been placed for determination in the hands of Dr. E. Coues—one of the most competent zoologists in the United States—and the result has been the very interesting memoir now before us. We knew already that Kerguelen's Land was not an inviting place of residence for the more highly organised animals, and that few birds were to be found there. We know now what those few are, and have full particulars about most of them, their lives, and habits. According to Dr. Coues' determination, Dr.

¹ This I state on the authority of Dr. Cayley, who assures me that on the high plains these afternoon winds are always from the west.

¹ "Bulletin of the United States National Museum," No. 2. Contributions to the Natural History of Kerguelen Island, made in connection with the American Transit of Venus Expedition, 1874-75. By J. H. Kidder, M.D. I. Ornithology. Edited by Dr. Elliott Coues, U.S.A., 8vo. 52 pp. (Washington, 1875.)

Kidder's collection contains examples of twenty-one species of this class, belonging to six families, namely, eleven Petrels, four Penguins, three Gulls, a Cormorant, a Duck, and a Sheath-bill. Of these, the two last-named are "the only partial vegetable feeders observed, all the other birds feeding exclusively on flesh, fish, or marine invertebrates." Of the *Chionis*, or Sheath-bills, a singular abnormal form related to the Plovers, of which there are (or were lately) living specimens in the Zoological Society's Gardens, Dr. Kidder might well have sung, in the words of the old song, "their tameness is shocking to me." "They would scarcely get out of my way," says the Doctor, "and seemed greatly interested in my movements. When I sat on a stone, keeping perfectly still, the whole party, twelve in all, came up to examine the intruder. They walked all around me, coming almost within reach; others flying up from more distant rocks to join them, and finally stopped, almost in a semi-circle, for a good stare. After watching the birds for a time, I shot four specimens, not without compunction, on account of killing such trustful acquaintances. When I walked off to get a sufficient distance away for a shot, the whole troop started to follow me, making little runs and stopping, as if filled with curiosity. I shot all four without moving from the spot, reloading for each, the birds not all flying out of range even after the gun had been fired. On subsequent occasions, various members of the party captured specimens by hand; all that was necessary to attract them within reach being to remain perfectly still. After one had been caught it served as a lure for others. When taken home alive they still showed no fear, but when let loose in the house took food readily."

Another curious fact observed is that in the absence of true birds of prey in Kerguelen's Land, the Skua of the Southern Seas (which Dr. Coues, widely departing from the ordinary binomial system designates as "*Buphagus skua antarcticus* (Les.), Coues"), appears to have taken upon itself all the habits and practices of a Buzzard or Kite. "It was at first taken for a hawk by all of us; its manner of flight, watchfulness of the ground over which it flew, and habit of perching on spots commanding a wide view, all suggested this impression. It was, indeed, difficult to believe the evidence of my own senses when I found a web-footed bird avoiding the water and preying solely, so far as my observations extended, upon other birds. When any of the party went out shooting he was pretty sure to be followed by one or two 'sea-hens,' as the sealers call them, and had often to be very prompt to secure his game before it should be carried off in his very presence."

Many details are likewise given respecting the habits of the other nineteen species observed, and great credit is due to Dr. Kidder and Dr. Coues for the speedy manner in which they have put together this interesting memoir. But what Mr. Eaton, the English naturalist at Kerguelen, and Mr. Sharp, who, we believe, has been, or is working out his birds, will say to it, we cannot tell. We fancy they will not be very much pleased at being thus forestalled.

MAYER'S RECENT ACOUSTICAL RESEARCHES¹

THIS communication is merely a preliminary note, to be followed by an elaborate paper on the above subjects. For conciseness and clearness, I present the few facts I have now to offer in the form of notes of experiments:—

¹ "On the Obliteration of one Sonorous Sensation by the simultaneous action of another more intense and lower Sound, and on the discovery of the remarkable fact that a Sound, even when very intense, cannot obliterate the sensations of another Sound Lower than it in Pitch; with Applications of these Discoveries to Measures of the Intensities of Sounds, and to the Proper Method of Conducting Orchestral Music." By Alfred M. Mayer, Ph.D., Member of the National (American) Academy of Sciences, and Professor of Physics in the Stevens Institute of Technology, Hoboken, New Jersey, U.S. America. Read before the National (American) Academy of Sciences, in Washington, April 20, 1876, and now first printed from the manuscript sent through Mr. Alex. J. Ellis, F.R.S.

Experimental Observations on the Obliteration of one Sound by another.—Several feet from the ear I placed one of those loud-ticking spring-balance American clocks, which make four beats in a second. Then I brought quite close to my ear a watch (made by Lange, of Dresden) ticking five times in the second. In this position I heard all the ticks of the watch, even those which coincided with every fourth tick of the clock. Let us call the fifth tick of the watch which coincided with one of the ticks of the clock, its fifth tick. I now gradually removed the watch from the ear, and perceived that the fifth tick became fainter and fainter, till at a certain distance it entirely vanished, and was, so to speak, "stamped out" of the watch.¹

Similar and more striking experiments were made with an old silver watch, beating four times to the second, by causing this watch to gain about thirty seconds an hour on the clock, so that at every two minutes the ticks of the watch and clock exactly coincided. When the watch was held near the ear, every one of its ticks was heard distinctly; but on gradually removing it from the ear, the ticks of the watch became fainter and fainter at the coincidences, and when the watch had been removed to a distance of nine inches from the ear, the ticks of the watch were utterly obliterated during three whole seconds of its ticks about the time of coincidence. On removing the watch to a distance of twenty-four inches, I found that I lost its ticks during nine seconds about the time of coincidence. It is here important to remark that the ticks of the clock are longer in duration, as well as lower in pitch, than those of the watches. With the watch remaining at the distance of twenty-four inches from the ear, I listened with all my attention, as tick by tick the watch approached the time of coincidence. Since the ticks of the watch are shorter in duration than those of the clock, they are overlapped by the other about the time of coincidence. Hence as, so to speak, the short ticks of the watch guided, tick after tick, under the long ticks of the clock, I perceived that more and more of the duration of each successive watch-tick became extinguished by the tick of the clock, until only the tail end of the short tick of the watch was left audible, and at last even this also crept under the long tick of the clock, and the whole of the ticks of the clock were rendered inaudible for nine seconds, at the end of which time the front or head of the watch-tick, as we may call it, protruded beyond the clock-tick, and then slowly grew up into a complete watch-tick as before. In this succession of events the tick of the old silver watch (made by Tobias) disappears with a sharp chirp, like a cricket's, and re-appears with a sound like that made by a boy's marble falling upon others in his pocket. By this experiment, therefore, a gradual analysis is made of the effect of the tick of the clock on the tick of the watch, affording a beautiful illustration of the fact that one sonorous sensation may overcome and obliterate another.

Experiments to determine the relative intensity of the Clock-ticks which obliterate three Watch-ticks.—The clock was placed on a post in the middle of an open level field in the country, on nights when the air was calm and noiseless. The ticks of the clock became just inaudible when my ear was removed to a distance of 350 feet. The ticks of the watch became just inaudible at a distance of twenty feet. The ratio of the squares of these numbers makes the ticks of the clock about 300 times more intense than those of the watch. On the same nights that I made the above determinations I also put the clock on the post, and placing against my zygomatic process a slender stick graduated to inches and tenths, I stood with my ear at distances from the clock of from eight to sixteen feet, and then slid the watch above and along the stick (taking care that it did not touch it) until it reached such a distance from the ear that its fifth tick just disappeared. Knowing the relative intensities of the ticks of clock and watch when placed at the same distance from the ear, the law of the reciprocals of the squares gives the relative intensities when the clock and watch are at the several distances obtained in the above experiments. Large numbers of such experiments have been made, and the results agree perfectly well when we take into consideration first, the difficulty

¹ The precise number of ticks in a second here mentioned are not necessary for roughly observing and understanding these phenomena. I observed them by a common American pendulum clock placed on a table, which increased the power of its half-second ticks, and a watch beating five times in two seconds. Rev. Mr. Haweis informs me that he has often noticed a similar effect at night with ordinary watches. The sensation produced by the obliteration of the tick, when the proper distance of the watch from the ear has been attained, and the consequent sudden division of the ticks into periods separated by silences, is very peculiar. It is difficult not to believe that some accident has not suddenly interfered with the action of the watch, instead of merely with our own sensations.—A. J. E.